BTeV WBS Dictionary

Subproject WBS Level 2 Element Number

WBS 1.19
System Installation, Integration and Testing

May 12, 2000

This document provides WBS Dictionary information
for a BTeV WBS Level 2 project and all its subprojects.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19

WBS Element Name:

System Installation, Integration and Commissioning

WBS Element Definition:

This element covers all installation tasks not explicitly covered in the individual subsystem sections of the WBS. The purpose 1.19 is to coordinate the subsections of the detector and insure they work together. Detector alignment and calibration are also covered in the section.

Ground Rules & Assumptions:

NA

Cost Estimate Source:

In lower levels

Basis of Cost Estimate:

NA

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.1

WBS Element Name:

System Installation

WBS Element Definition:

This element covers all installation tasks not explicitly covered in the individual subsystems. Support items such as cable trays and cable installation. Relay rack installation and associated items such as cooling, power supplies, etc. are covered herein.

Ground Rules & Assumptions:

The installation of each detector subsystem is included in the WBS section for that subsystem.

Cost Estimate Source:

This element is rolled up from lower levels.

Basis of Cost Estimate:

The time estimates are from past experience in installing and testing large detectors at FNAL.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.1.1

WBS Element Name:

Site Installation Crew (3 Technicians)

WBS Element Definition:

This element is meant to cover the multitude of installation tasks that are not covered elsewhere in this proposal.

Ground Rules & Assumptions:

We assume that a three technician crew will work full time for three years on BTeV installation, integration testing and commissioning tasks.

Cost Estimate Source:

Fermilab labor cost for technicians.

Basis of Cost Estimate:

Past experience and observation of other similar size experiment installations at Fermilab.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.1.2

WBS Element Name:

Detector and Counting Room Cable Trays

WBS Element Definition:

Cable trays shared by cables for more than one subsystem.

Ground Rules & Assumptions:

Costs placed here for cable trays since instead of subsections since they are a shared facility.

Cost Estimate Source:

Fermilab labor rates

Basis of Cost Estimate:

Cable trays are from other similar installations at FNAL. Personnel times are from past experience with similar installations.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.1.3

WBS Element Name:

Cable Installation

WBS Element Definition:

This element covers all of the cable plant from the detector to the counting room.

Ground Rules & Assumptions:

This is meant to cover odds and ends not covered elsewhere; for instance some BTeV-wide monitoring systems may need cables which are not included in any detector WBS

Cost Estimate Source:

Fermilab labor rates

Basis of Cost Estimate:

Personnel times are from past experience with similar installations. Adjustments made for unforeseen problems at other installations.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.1.3.1

WBS Element Name:

On and Near-Detector

WBS Element Definition:

Cables not included in any other WBS item.

Ground Rules & Assumptions:

These are things we haven't thought of yet.

Cost Estimate Source:

Fermilab labor rates

Basis of Cost Estimate:

Past experience.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.1.3.2

WBS Element Name:

Detector to Counting Room

WBS Element Definition:

Ground Rules & Assumptions:

Cost Estimate Source:

Fermilab labor rates

Basis of Cost Estimate:

Past experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.1.3.3

WBS Element Name:

Relay Rack and Subrack Installation, Powering , & Cooling

WBS Element Definition:

Install generic relay racks and associated hardware.

Ground Rules & Assumptions:

BTeV will recycle existing racks from completed experiments. Power and cooling hardware is costed is each subsection.

Cost Estimate Source:

Fermilab labor rates

Basis of Cost Estimate:

Past experience

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BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.2

WBS Element Name:

Procedure Specification

WBS Element Definition:

This element will set the procedures for start up, run time and error recovery. This item needs to be implemented at the start of the detailed design since some features the software will need will have to be implemented in the hardware.

Ground Rules & Assumptions:

N/A

Cost Estimate Source:

This element is rolled up from lower levels.

Basis of Cost Estimate:

Past experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.2.1

WBS Element Name:

Run Startup & Stop & Partitioning

WBS Element Definition:

Establish procedures for system synchronization at the start of each run.
Establish procedure for stopping a run.
Establish procedure for running subsections of the DAQ independently of one another (partitioning).

Ground Rules & Assumptions:

N/A

Cost Estimate Source:

Fermilab labor rates

Basis of Cost Estimate:

Past experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.2.2

WBS Element Name:

Halt/Reset/Run & Error Recovery

WBS Element Definition:

Establish procedures for Halt/Reset/Run
Establish procedures for Error Recovery

Ground Rules & Assumptions:

N/A

Cost Estimate Source:

Fermilab labor rates

Basis of Cost Estimate:

Past experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.3

WBS Element Name:

Commission Control, Timing, and Monitoring System

WBS Element Definition:

This element covers the installation and testing of the Control/Monitoring and Timing system. The work will be coordinated with the accelerator clock group.

Ground Rules & Assumptions:

The Control and monitoring system will be designed explicitly for BteV. The clock system installation (design elsewhere) will rely on recent past experience at CDF and D0.

Cost Estimate Source:

Fermilab labor rates

Basis of Cost Estimate:

Past experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.4

WBS Element Name:

Establish Simplest Data Readout Path

WBS Element Definition:

Download test patterns into level 1 buffers; readout into computer.

Ground Rules & Assumptions:

Subsystems have been tested and are presumed to be functional

Cost Estimate Source:

Fermilab labor rates

Basis of Cost Estimate:

Past experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.5

WBS Element Name:

Integrate Accelerator Clock with BTeV Control/Monitoring and Timing System

WBS Element Definition:

This item and 1.19.4 are done in conjunction with each other. The clock is necessary in the operation of the front-end systems.

Ground Rules & Assumptions:

See 1.19.4

Cost Estimate Source:

Fermilab labor rates

Basis of Cost Estimate:

Past experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.6

WBS Element Name:

Establish Front-End Timing

WBS Element Definition:

The timing has to be synchronized at all front-end subsystems. The clock offsets have to be determined so the crossing time reads the same for the same event from all subsystems.

Ground Rules & Assumptions:

Assume that the timing distribution system has been tested and all subsystems can accept the clock and read back data.

Cost Estimate Source:

Fermilab labor rates

Basis of Cost Estimate:

Time estimates based on experience from CDF and D0.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.6.1

WBS Element Name:

Pixel

WBS Element Definition:

This element checks the front-end timing with Pixels. The test will phase the BCO clock for each chip. Also the test will synchronize reset and startup procedure. Establish use of throttle.

Ground Rules & Assumptions:

Pixel system has been tested and assumed to be functional

Cost Estimate Source:

Fermilab labor rates

Basis of Cost Estimate:

Past experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.6.2

WBS Element Name:

RICH

WBS Element Definition:

This element checks the front-end timing at the RICH detector. Also the test will synchronize reset and startup procedure. Establish use of throttle.

Ground Rules & Assumptions:

RICH system has been tested and assumed to be functional

Cost Estimate Source:

Fermilab labor rates

Basis of Cost Estimate:

Past experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.6.3

WBS Element Name:

EM Calorimeter

WBS Element Definition:

This element checks the front-end timing at the EM Calorimeter. Also the test will synchronize reset and startup procedure. Establish use of throttle.

Ground Rules & Assumptions:

EM Calorimeter system has been tested and assumed to be functional

Cost Estimate Source:

Fermilab labor rates

Basis of Cost Estimate:

Past experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.6.4

WBS Element Name:

Muon

WBS Element Definition:

This element checks the front-end timing at the Muon system. Also the test will synchronize reset and startup procedure. Establish use of throttle.

Ground Rules & Assumptions:

Muon system has been tested and assumed to be functional

Cost Estimate Source:

Fermilab labor rates

Basis of Cost Estimate:

Past experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.6.5

WBS Element Name:

Straws

WBS Element Definition:

This element checks the front-end timing at the Straw detector. Also the test will synchronize reset and startup procedure. Establish use of throttle.

Ground Rules & Assumptions:

Straws system has been tested and assumed to be functional

Cost Estimate Source:

Fermilab labor rates

Basis of Cost Estimate:

Past experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.6.6

WBS Element Name:

Silicon Strip Detectors

WBS Element Definition:

This element checks the front-end timing at the Silicon Strip Detector. Also the test will synchronize reset and startup procedure. Establish use of throttle.

Ground Rules & Assumptions:

Silicon Strip system has been tested and assumed to be functional

Cost Estimate Source:

Fermilab labor rates

Basis of Cost Estimate:

Past experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.7

WBS Element Name:

System Integration without Triggers or Event Builder

WBS Element Definition:

This item checks all data paths using the CM&T system to down load data patterns. Data is buffered and then read into processors for checking.

Ground Rules & Assumptions:

The testing will be done in stages. First one front-end systems at a time, then 2 at a time, 3 at a time, … all. This staged approach should make trouble shooting simpler.

Cost Estimate Source:

Fermilab labor costs.

Basis of Cost Estimate:

Experience with CDF and D0 detectors with estimates modified for the BTeV detector.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.8

WBS Element Name:

Level 1 Trigger Testing

WBS Element Definition:

This element will test the Level 1 Trigger with simulated data and later real tracks. The simulated data will be a first test of the trigger algorithms implemented in the hardware. The results of the hardware trigger will be compared with simulated triggers.

Ground Rules & Assumptions:

The subsystems and data paths have been previously tested.

Cost Estimate Source:

This element is rolled up from lower levels.

Basis of Cost Estimate:

Prior experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.8.1

WBS Element Name:

Pixel Trigger

WBS Element Definition:

Hardware trigger will be tested against the simulated triggers. Later real event data will be checked.

Ground Rules & Assumptions:

This subsystem is functional and the CM&T paths are working.

Cost Estimate Source:

Fermilab labor rates

Basis of Cost Estimate:

Prior experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.8.2

WBS Element Name:

Muon Trigger

WBS Element Definition:

Hardware trigger will be tested against the simulated triggers. Later real event data will be checked.

Ground Rules & Assumptions:

This subsystem is functional and the CM&T paths are working.

Cost Estimate Source:

Fermilab labor rates

Basis of Cost Estimate:

Prior experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.8.3

WBS Element Name:

Integration and testing of pixel trigger with global trigger.

WBS Element Definition:

Hardware trigger will be tested against the simulated triggers. Later real event data will be checked.

Ground Rules & Assumptions:

All subsystems are functional and the CM&T paths are working.

Cost Estimate Source:

Fermilab labor rates

Basis of Cost Estimate:

Prior experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.8.4

WBS Element Name:

Integration and Testing of Muon Trigger with Global Trigger

WBS Element Definition:

Hardware trigger will be tested against the simulated triggers. Later real event data will be checked.

Ground Rules & Assumptions:

This subsystem is functional and the CM&T paths are working.

Cost Estimate Source:

Fermilab labor rates

Basis of Cost Estimate:

Prior experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.9

WBS Element Name:

Partial Data Acquisition System Testing

WBS Element Definition:

Level 1 buffers to Level 2/3 Processor Array data paths are checked.

Ground Rules & Assumptions:

Assume that the subsystems have been tested and are working. Test data will be from simulations and test patterns.

Cost Estimate Source:

Fermilab labor rates

Basis of Cost Estimate:

Past experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.10

WBS Element Name:

Integration of Front-End Systems and Their Triggers

WBS Element Definition:

This element will test the trigger and event builder with simulated data and later real tracks. The simulated data will be a first test of the trigger algorithms implemented in the hardware. The results of the hardware trigger will be compared with simulated triggers. The data to the event builder will also be compared to the simulated data for accuracy.

Ground Rules & Assumptions:

The testing will be done in stages. First one front-end systems at a time, then 2 at a time, 3 at a time, … all. This staged approach should make trouble shooting simpler.

Cost Estimate Source:

Fermilab labor rates

Basis of Cost Estimate:

Experience with CDF and D0 detectors with estimates modified for the BTeV detector.

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.11

WBS Element Name:

System Integration Testing and Commissioning

WBS Element Definition:

Full front-end, trigger, and DAQ system integration testing and commissioning

Ground Rules & Assumptions:

All subsystems have been tested and are assumed to be working.

Cost Estimate Source:

Fermilab labor rates

Basis of Cost Estimate:

Past experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.12

WBS Element Name:

Establish and Test DAQ Procedures

WBS Element Definition:

Establish and test system startup procedure, end of run procedure, and error handling procedures.

Ground Rules & Assumptions:

Specification have been set prior to subsystems designing hardware. This will test that hardware.

Cost Estimate Source:

Fermilab labor rates

Basis of Cost Estimate:

Past experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.12.1

WBS Element Name:

Induced Errors and System Recovery Testing

WBS Element Definition:

Error patterns can be down-loaded via the C/M and T paths. The hardware can then be tested to determine if these errors are detectable.

Ground Rules & Assumptions:

All subsystems have hardware designed to allow error testing. The specifications were established prior to design.

Cost Estimate Source:

Fermilab labor rates

Basis of Cost Estimate:

Past experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.13

WBS Element Name:

Establish Detector Alignment Procedures

WBS Element Definition:

Alignments will be performed within individual systems and from system-to-system. Requirements for alignment will be established prior to construction.

Ground Rules & Assumptions:

N/A

Cost Estimate Source:

This element is rolled up from lower levels

Basis of Cost Estimate:

N/A

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.13.1

WBS Element Name:

Pixel

WBS Element Definition:

Alignment will be a combination of surveying and track reconstruction with the latter as the definitive test.

Ground Rules & Assumptions:

A mechanical alignment will be performed with surveying instruments before the detector is installed. Procedures will be developed for use *in situ*. Repeatability of the plane movement system (accelerator beam loading avoidance) will be checked. Tracking software specific for alignment will be developed.

Cost Estimate Source:

This element is rolled up from lower levels. Fermilab labor rates used.

Basis of Cost Estimate:

Past experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.13.2

WBS Element Name:

RICH

WBS Element Definition:

Alignment will be a combination of surveying and track reconstruction with the latter as the definitive test.

Ground Rules & Assumptions:

Detector will have survey targets to aid in surveying. The final check will be track data analysis.

Cost Estimate Source:

Fermilab labor costs

Basis of Cost Estimate:

Past experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.13.3

WBS Element Name:

EM Calorimeter

WBS Element Definition:

Alignment will be a combination of surveying and track reconstruction with the latter as the definitive test.

Ground Rules & Assumptions:

Detector will have survey targets to aid in surveying. The final check will be track data analysis.

Cost Estimate Source:

Fermilab labor costs

Basis of Cost Estimate:

Past experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.13.4

WBS Element Name:

Muon

WBS Element Definition:

Alignment will be a combination of surveying and track reconstruction with the latter as the definitive test.

Ground Rules & Assumptions:

Detector will have survey targets to aid in surveying. The final check will be track data analysis.

Cost Estimate Source:

Fermilab labor costs

Basis of Cost Estimate:

Past experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.13.5

WBS Element Name:

Straws

WBS Element Definition:

Alignment will be a combination of surveying and track reconstruction with the latter as the definitive test.

Ground Rules & Assumptions:

Detector will have survey targets to aid in surveying. The final check will be track data analysis.

Cost Estimate Source:

Fermilab labor costs

Basis of Cost Estimate:

Past experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.13.6

WBS Element Name:

Silicon Strip Detectors

WBS Element Definition:

Alignment will be a combination of surveying and track reconstruction with the latter as the definitive test.

Ground Rules & Assumptions:

Detector will have survey targets to aid in surveying. The final check will be track data analysis.

Cost Estimate Source:

Fermilab labor costs

Basis of Cost Estimate:

Past experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.14

WBS Element Name:

Establish Detector Calibration Procedures

WBS Element Definition:

This item coordinates the overall detector calibration. This item is mainly software development to integrate subsystem specific software into the overall BTeV software package.

Ground Rules & Assumptions:

Subsystems develop their own specific calibration techniques. This item integrates them for use in overall detector calibration and for run time checks.

Cost Estimate Source:

Roll up of items below

Basis of Cost Estimate:

Past experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.14.1

WBS Element Name:

Pixel

WBS Element Definition:

This element deals with the calibration specific to the Pixel detector and how to integrate it with the overall BTeV calibration software.

Ground Rules & Assumptions:

Calibration specific to this subsystem is under the subsystem specific details.

Cost Estimate Source:

Fermilab labor costs

Basis of Cost Estimate:

Past experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.14.1

WBS Element Name:

RICH

WBS Element Definition:

This element deals with the calibration specific to the RICH detector and how to integrate it with the overall BTeV calibration software.

Ground Rules & Assumptions:

Calibration specific to this subsystem is under the subsystem specific details.

Cost Estimate Source:

Fermilab labor costs

Basis of Cost Estimate:

Past experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.14.3

WBS Element Name:

EM Calorimeter

WBS Element Definition:

This element deals with the calibration specific to the EM Calorimeter and how to integrate it with the overall BTeV calibration software.

Ground Rules & Assumptions:

Calibration specific to this subsystem is under the subsystem specific details.

Cost Estimate Source:

Fermilab labor costs

Basis of Cost Estimate:

Past experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.14.4

WBS Element Name:

Muon

WBS Element Definition:

This element deals with the calibration specific to the Muon detector and how to integrate it with the overall BTeV calibration software.

Ground Rules & Assumptions:

Calibration specific to this subsystem is under the subsystem specific details.

Cost Estimate Source:

Fermilab labor costs

Basis of Cost Estimate:

Past experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.14.5

WBS Element Name:

Straws

WBS Element Definition:

This element deals with the calibration specific to the Straw detector and how to integrate it with the overall BTeV calibration software.

Ground Rules & Assumptions:

Calibration specific to this subsystem is under the subsystem specific details.

Cost Estimate Source:

Fermilab labor costs

Basis of Cost Estimate:

Past experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.14.6

WBS Element Name:

Silicon Strip Detectors

WBS Element Definition:

This element deals with the calibration specific to the Silicon Strip detector and how to integrate it with the overall BTeV calibration software.

Ground Rules & Assumptions:

Calibration specific to this subsystem is under the subsystem specific details.

Cost Estimate Source:

Fermilab labor costs

Basis of Cost Estimate:

Past experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.15

WBS Element Name:

ES&H

WBS Element Definition:

All overall safety issues are covered in this item. Subsystem specific items are under the appropriate subsection. Interlocks between subsystems and the accelerator are included here.

Ground Rules & Assumptions:

Assume all subsystems comply at the "internal" subsystem level. The overall interaction between subsystems is checked here. The review here should lead to operational of the detector from the laboratory.

Cost Estimate Source:

This element is rolled up from lower levels.

Basis of Cost Estimate:

Past experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.15.1

WBS Element Name:

Compliance-Testing and Verification

WBS Element Definition:

All subsystems are checked for compliance with Fermilab regulations. The items include electrical safety (high and low voltage), cooling, hazardous materials (gases, chemicals, radioactive, etc).

Ground Rules & Assumptions:

Assume that all subsystems have had prior reviews and this is the final check before operational approval is given by the laboratory.

Cost Estimate Source:

This element is rolled up from lower levels. Fermilab labor costs.

Basis of Cost Estimate:

Past experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.15.2

WBS Element Name:

Training

WBS Element Definition:

This item disseminates information to the BTeV personnel. The training sessions on safety and operations are held as required.

Ground Rules & Assumptions:

Subsystems will conduct training specific to each. This item covers overall BTeV training issues.

Cost Estimate Source:

Fermilab labor costs

Basis of Cost Estimate:

Past experience

BTeV WBS Dictionary
Basis of Cost Estimate

WBS Element Number:

1.19.16

WBS Element Name:

System Installation, Integration & Commissioning Project Management

WBS Element Definition:

This element consists of the costs associated with all management activities related to the system installation, integration & commissioning project management.

Ground Rules & Assumptions:

This element includes coordination of the work carried out at various institutes, site-visit, vendor visit, book-keeping, accounting, and reporting to internal and external reviews of the project. Review at regular intervals is necessary to keep track of the progress of the project. Travel to various sites are needed to coordinate the smooth running of the project and the timely delivery of components needed from the vendors.

Cost Estimate Source:

The cost is basically an estimate of the number of travels that is deemed to be necessary. It also includes the time that it will take the engineers and technicians to prepare and attend the reviews. Labor is costed at Fermilab rates. All trips are based on experience and costed based on place and length of travel.

Basis of Cost Estimate:

Estimate is based on experiences with projects of similar complexity.